March 24, 1959 R. R. WAREHAM 2,878,736

SHUTTER AND DIAPHRAGM MECHANISM FOR CAMERAS

Filed April 29, 1955

4 Sheets-Sheet 1

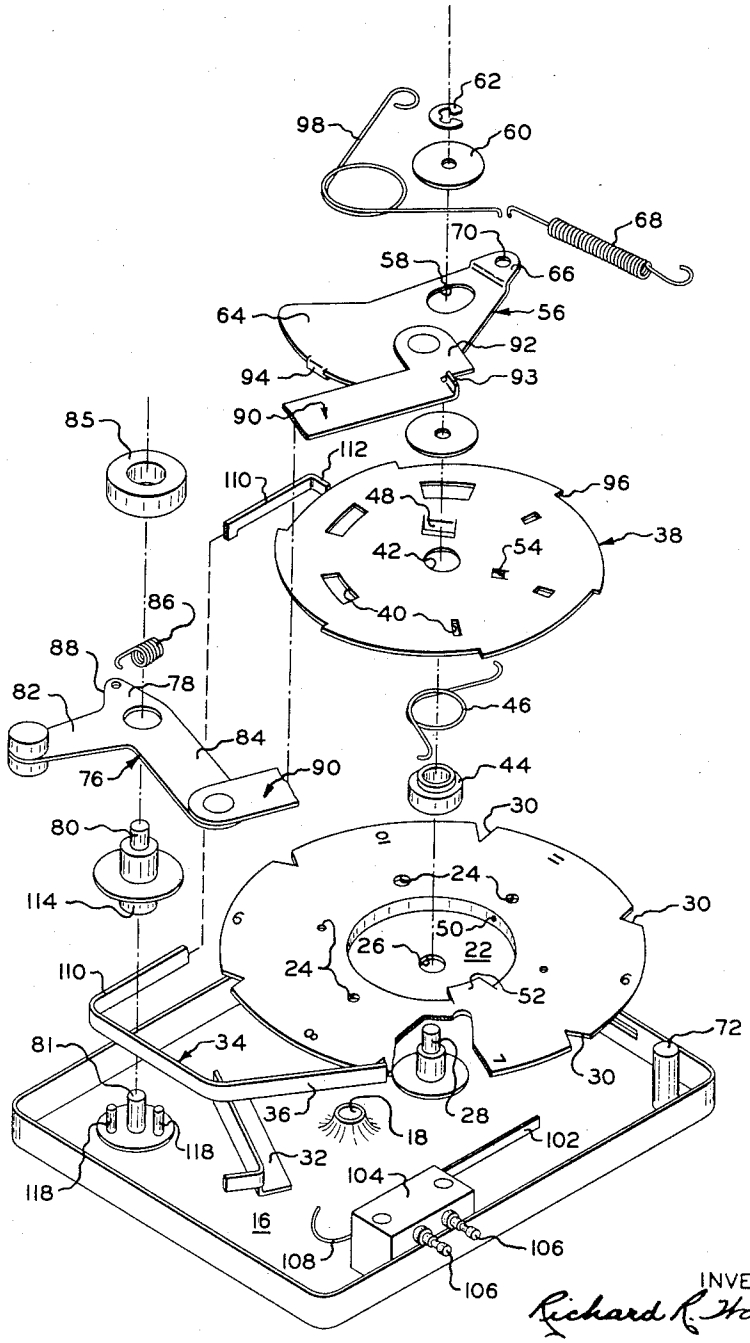


FIG. 1

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4 Sheets-Sheet 2

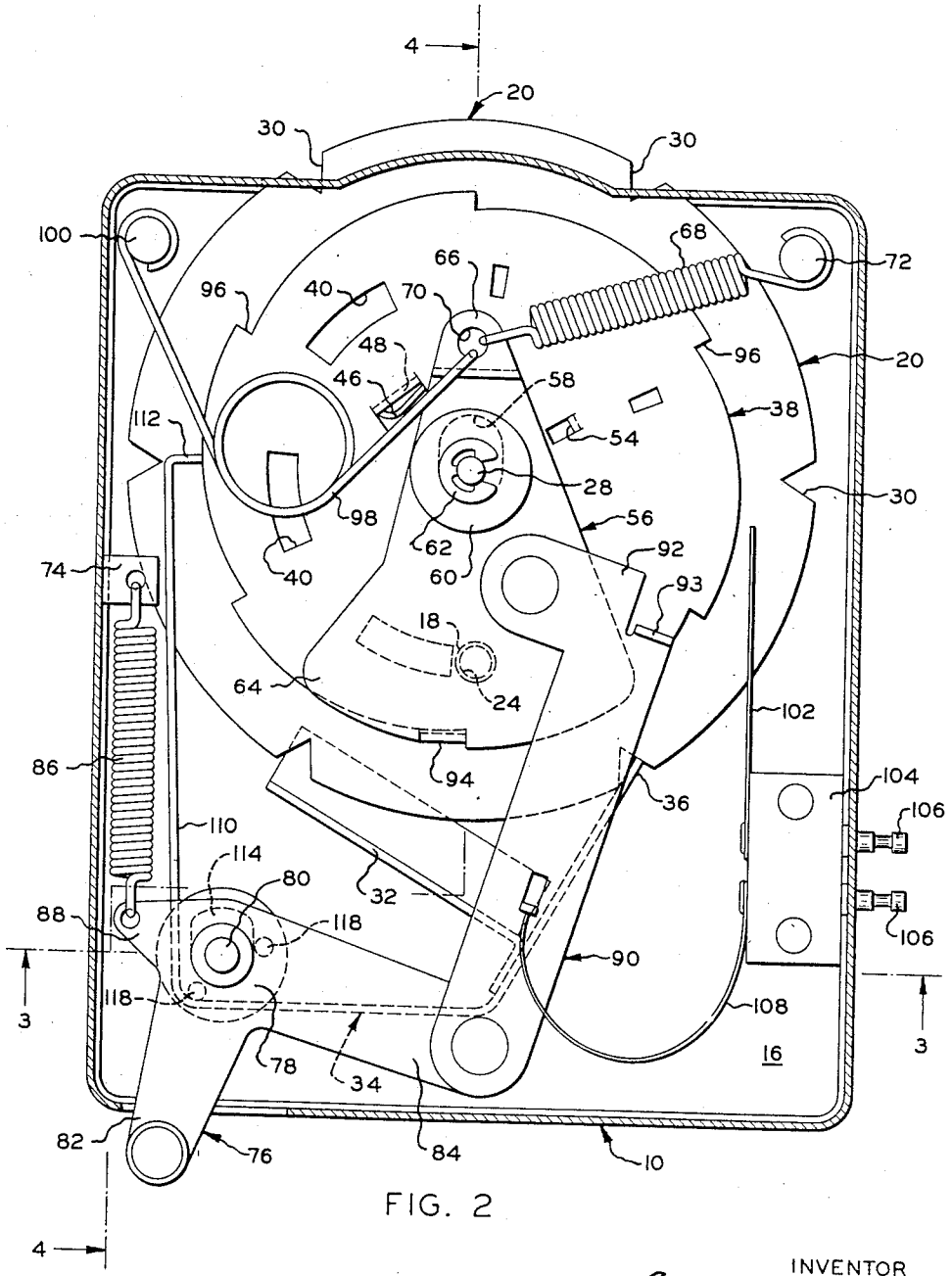


FIG. 2

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4 Sheets-Sheet 3

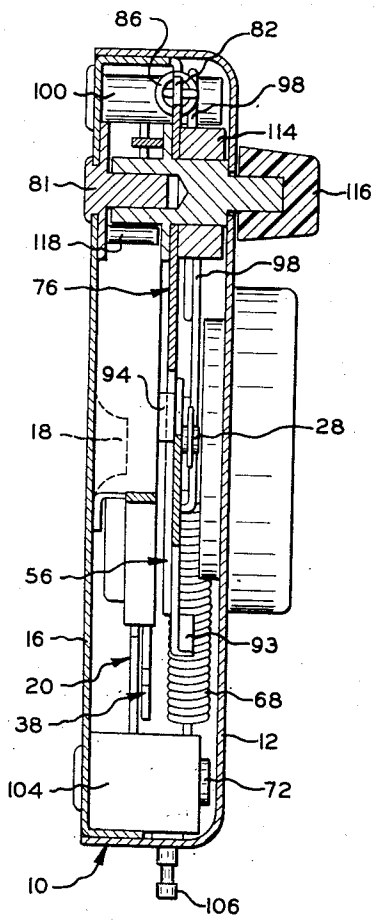


FIG. 3

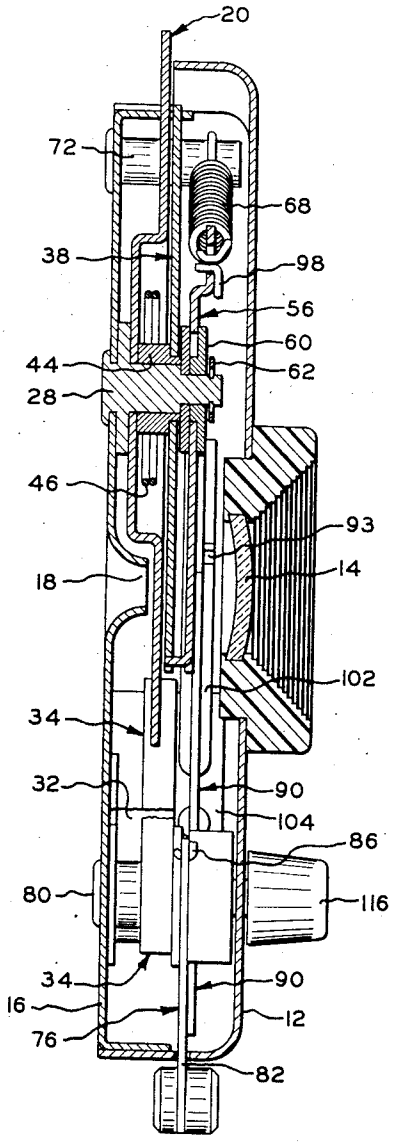


FIG. 4

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SHUTTER AND DIAPHRAGM MECHANISM FOR CAMERAS

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4 Sheets-Sheet 4

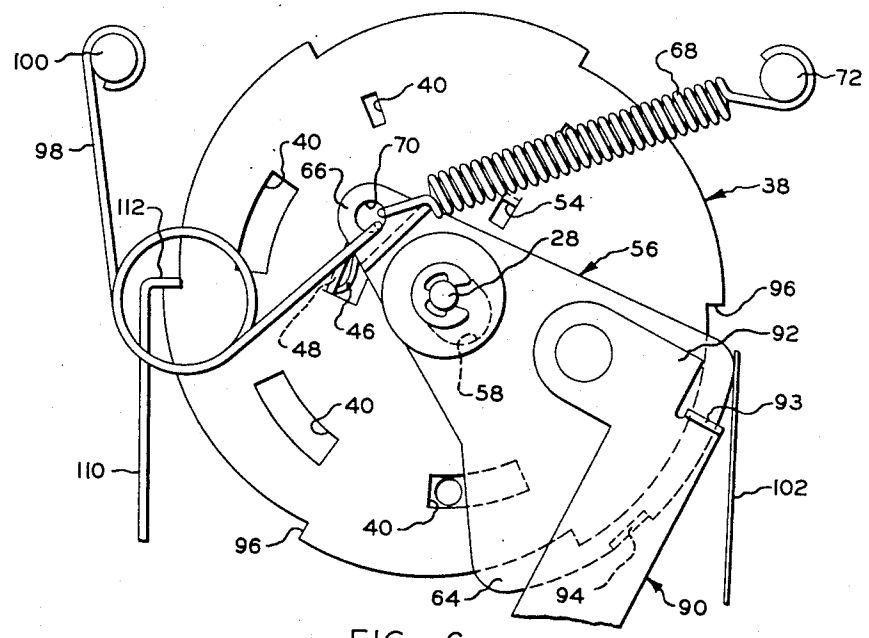


FIG. 6

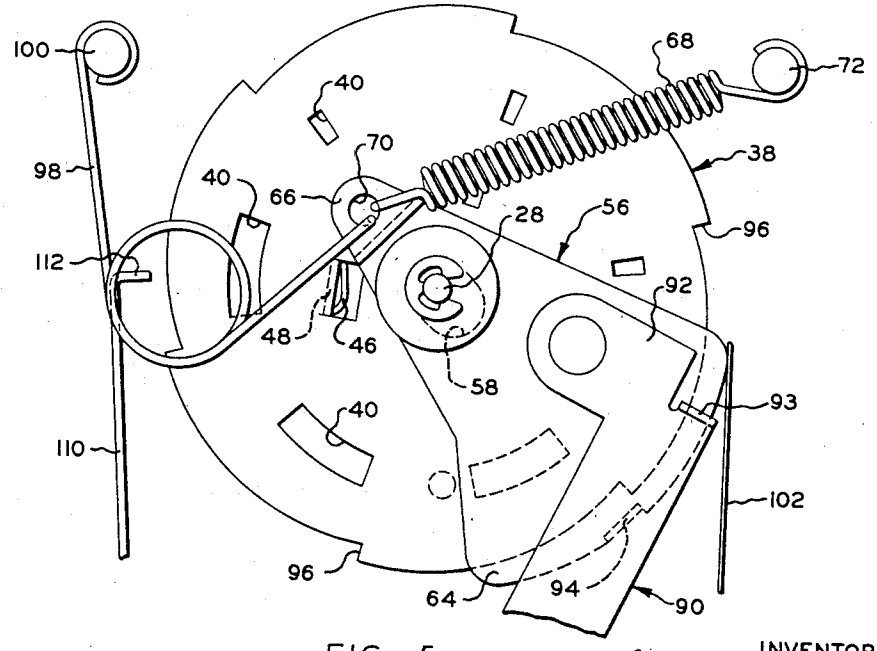


FIG. 5

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2,878,736

SHUTTER AND DIAPHRAGM MECHANISM FOR CAMERAS

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Application April 29, 1955, Serial No. 504,757

13 Claims. (Cl. 95—64)

This invention relates to photography and, more particularly, to novel shutter and diaphragm mechanism.

A principal object of the present invention is to provide a relatively simple and inexpensive camera shutter including blade and cover-blind elements operatively associated with a diaphragm element providing a plurality of operational settings of said elements to accurately predetermine exposure values.

Another object of the present invention is to provide, in a camera shutter including a blade and cover blind, a rotary diaphragm coupled with said blade and cover blind and pivotable to a plurality of positions for setting up camera shutter speeds and aperture diameters suitable for employment with one another for providing predetermined given exposures.

A further object of the present invention is to provide, in a shutter of the above type, a disc-type diaphragm coupled with said blade and cover blind and having inscribed thereupon a plurality of numbers representing a plurality of predetermined light values, and being rotatable for positioning said numbers adjacent a fixed index, thereby setting up a shutter speed and aperture diameter suitable for providing a given exposure.

Still another object of the present invention is to provide a shutter of the blade and cover-blind type particularly adapted to lenses of small aperture and having uniformly accurate operational speed with a single control element providing novel means for varying shutter speed and size of diaphragm apertures.

Still further objects of the present invention are to provide, in a camera shutter, a disc-type shutter blade, a cover blind coaxially mounted with the shutter blade, means for pivoting the shutter blade into cocked position, said cover blind including means for engaging and pivoting said shutter blade into cocked position during cocking movement of said cover blind, and means for causing said cover blind to release said shutter blade for operation when the latter is in cocked position; to provide a cover blind of the above type mounted for both linear and pivotal movement; and to provide novel means including said cover blind for completing a photoflash circuit in synchronism with the release of said shutter blade for operation.

Other objects of the invention will in part be obvious and will in part appear hereinafter.

The invention accordingly comprises the apparatus possessing the construction, combination of elements and arrangement of parts which are exemplified in the following detailed disclosure, and the scope of the application of which will be indicated in the claims.

For a fuller understanding of the nature and objects of the invention, reference should be had to the following detailed description taken in connection with the accompanying drawings wherein:

Figure 1 is an exploded view illustrating in perspective the elements of a shutter embodying the present invention;

Fig. 2 is a front plan view of the shutter of Fig. 1 illustrated at the position of rest with the time latch in "instantaneous" position;

Fig. 3 is a section taken along the line 3—3 of Fig. 2;

Fig. 4 is a section taken along the line 4—4 of Fig. 2;

Fig. 5 is a plan view similar to that of Fig. 2 and illustrating the elements of the shutter at the instant of release; and

Fig. 6 is a plan view similar to that of Fig. 5 taken an instant after release of the shutter with the shutter blade shown retained in "bulb" exposure position.

Generally, the present invention comprehends the provision of a shutter which is relatively simple and inexpensive in construction and capable of being set for a plurality of accurately predetermined shutter speeds. Shutter speed, as referred to herein, is to be regarded in terms of an exposure period during which light passes through the lens aperture. The shutter includes a pivotable shutter blade having therein a plurality of arcuate slots and a cover blind. The shutter blade is pivotable from a position of rest, with one of the arcuate slots positioned at one side of the lens aperture, to a cocked position, with said one slot positioned adjacent the other side of the lens aperture. The cover blind covers the lens aperture as said one slot moves across said aperture during pivotal movement of the shutter blade into cocked position, and is positioned to one side of the lens aperture during the return movement of the shutter blade as the slot passes across and uncovers the lens aperture. The exposure period is determined by the length of the slot and the speed of movement of the slot across the lens aperture. The shutter is adapted to incorporation with any of a variety of conventional cameras and is particularly suitable for use in cameras employing lenses of fixed focus and small relative aperture which are adapted to exposure of films having a "fast" emulsion. A rotatable disc-type diaphragm having a plurality of apertures of predetermined diameter is directly coupled with the shutter blade for controlling the shutter speed setting. This disc-type diaphragm permits formation therein of small apertures of exact light-admitting properties and is provided with indicia such as numbers for indicating the setting for particular combinations of shutter speed and aperture diameter.

Referring now to the drawings wherein like numerals denote like parts, there is shown in Figs. 1 through 5 a shutter mechanism, comprehended by the present invention, the associated elements of which are represented in Figs. 2 and 5 as they would appear from a position in front of the camera. Directions of the rotation and movement of the elements as hereinafter described are those which would be observed when said elements are viewed from the above described position, the descriptive language being in accordance with said point of observation.

As a means for enclosing and mounting the operative elements of the shutter mechanism, there is provided a generally rectangular housing **10** including a front portion **12**, shown as mounting a conventional lens **14**, and a rear portion **16** having a lens aperture **18** in alignment with the axis of lens **14**. Front and rear portions **12** and **16** include relatively short side walls, the side walls of front portion **14** extending exteriorly of the side walls of rear portion **16** to aid in preventing the leakage of light through aperture **18**.

An aperture control means is provided in association with lens aperture **18**, said means comprising a disc-type diaphragm **20**. Diaphragm **20** includes a central dished or recessed section **22**, a plurality of evenly spaced exposure apertures **24** having predetermined diameters and a hole **26** at its center at which disc **20** is pivotally mounted to permit movement of any of apertures **24** into operative alignment with lens aperture **18**. A short

post or shaft 28 is secured in rear portion 16 and extends forward for pivotally mounting diaphragm 20 at hole 26 together with other elements of the shutter assembly. So that disc 20 may be rotated for bringing any particular aperture 24 into alignment with lens aperture 18, disc 20 is so mounted that a portion of its periphery extends through a slot in the side wall of housing 10 exteriorly of the housing and is manually engageable for pivoting the diaphragm. In order to hold an aperture 24 of disc 20 in operatively aligned position, disc 20 is provided with a plurality of evenly spaced V-shaped notches 30 around its periphery, there being provided one notch for each aperture 24. A bracket 32 is secured to rear portion 16 for mounting an elongated detent spring 34 having one end portion 36 adapted to engage notches 30 so as to permit the rotation of disc 20 in only a counterclockwise direction and to retain disc 20 with any selected aperture 24 in alignment with lens aperture 18.

To control the passage of light through lens aperture 18 of the shutter, there is provided a shutter blade comprising a generally flat disc 38 having therein a plurality of predeterminedly spaced arcuate slots 40 of varying lengths. Shutter disc 38 includes a round opening 42 at its center at which shutter disc 38 is pivotally mounted adjacent diaphragm 20 on a hub 44 mounted on post 28. Shutter disc 38 is so mounted on hub 44 that slots 40 are movable in alignment with and across lens aperture 18 in order to uncover said aperture, the duration of the exposure effected thereby being proportional to the length of the slot crossing the lens aperture.

Shutter disc 38 is normally biased in a clockwise direction by a torsion spring 46 coiled around post 28 and positioned between shutter disc 38 and diaphragm disc 20 in dished section 22 of disc 20. Spring 46 is anchored at one end to a tab 48 turned up from shutter disc 38 toward diaphragm disc 20 and at its other end in a small hole 50 at the edge of dished section 22 of disc 20. Limit stops are provided for normally positioning shutter disc 38 so that a portion of said disc, between a pair of slots 40, overlies an exposure aperture 24 in alignment with lens aperture 18. These limit stops include tab 48 on shutter disc 38 adapted to engage a tab 52, turned up from diaphragm disc 20 toward disc 38, and thereby retain disc 38 against movement due to the bias of spring 46.

To move shutter disc 38 into a cocked position, the shutter disc is pivoted in a counterclockwise direction against the bias of spring 46 until a particular slot 40, which is normally positioned adjacent one side (the left viewing Fig. 2) of lens aperture 18, has moved across the lens aperture to the other side thereof. In order to prevent disc 38 from being pivoted too far in a counterclockwise direction so that another of slots 40 becomes aligned with lens aperture 18, there is provided a means for limiting the movement of said disc and, in the form shown, comprises a tab 54 turned up from shutter disc 38 toward diaphragm disc 20 and adapted to engage tab 52 on disc 20.

The shutter makes an exposure during the clockwise pivotal movement of the shutter disc under the bias of spring 46 from its cocked position to its original position of rest. The duration of the exposure, or the "shutter speed," is dependent upon the length of the slot which crosses the lens aperture and the rotational speed of disc 38 due to the force exerted by spring 46, and may be varied by rotating shutter disc 38 in a counterclockwise direction so as to move a particular one of slots 40 into position to cross lens aperture 18 and admit light therethrough. Rotation of shutter disc 38 provides for different shutter speeds and is effected by rotation of diaphragm disc 20 in a counterclockwise direction so that tab 52 on disc 20 engages tab 48 on shutter disc 38 to pivot disc 38 together with spring 46 in a clockwise direction with disc 20.

Diaphragm disc 20 is provided with a plurality of numbers inscribed on its peripheral portion which extends exteriorly of housing 10, one number being associated with each exposure aperture 24 and representing a light value. The light values may preferably correspond to light value numbers carried on the scale of a conventional exposure meter, thus permitting setting of the shutter directly according to the prevailing light value number indicated on the exposure meter scale without the necessity of first computing a correct setting. Rotation of diaphragm disc 20 to bring a given number thereon into view exteriorly of the shutter housing sets up a correlated shutter speed and diaphragm aperture providing a predetermined exposure value. In the illustrated embodiment, for example, the shutter may be set for any of six exposure values, diaphragm disc 20 being provided with six exposure apertures with numbers 6 through 11 around its periphery and shutter disc 38 including six exposure slots 40. Assuming the lowest number to indicate a low light value, for a prevailing light value of low intensity, diaphragm disc 20 is set so that No. 6 is visible on the portion of said disc extending exteriorly of housing 10. Thus, the largest exposure aperture of disc 20 is positioned in alignment with lens aperture 18 and the longest exposure slot 40 of shutter disc 38 is positioned adjacent and to one side (the left viewing Fig. 2) of the exposure aperture. In one form of shutter, for example having a lens of relatively small aperture, diaphragm disc 20 is provided with two sets of three apertures, the apertures of each set being so formed as to provide for three full stop steps such as $f/30$, $f/42$ and $f/60$, and shutter disc 38 includes two sets of three slots, the slots in each set being of equal length. Each set of three slots in disc 38 is operatively associated with a set of three apertures in disc 20, the slots being so formed as to provide for exposures of $\frac{1}{25}$ of a second at $f/30$, $f/42$ and $f/60$, and $\frac{1}{200}$ of a second at $f/30$, $f/42$ and $f/60$. By virtue of this arrangement, rotation of disc 20 through one full revolution is sufficient to set the shutter for any one of the series of six exposure values, each of which is one half the previous one.

As a means for pivoting shutter disc 38 into cocked position and covering the exposure aperture during pivotal movement of the disc, there is provided a cover blind or blade 56. Blade 56 is generally triangular in shape and includes a slot 58 mediate its ends and at which said blade is pivotally and slidably mounted adjacent shutter disc 38 on a hub 60 mounted on post 28 and retained thereon by a conventional retaining ring 62. The axis of slot 58 extends generally lengthwise of blade 56 and the center of post 28 is positioned to the left of lens aperture 18. Cover blind 56 includes a generally flat end section 64 positioned closely adjacent disc 38 and being enlarged so as to cover the lens aperture during pivotal movement of blade 56 during cocking of the shutter and a tapered end section 66. Blade 56 is normally retained in the position of rest covering lens aperture 18 by a coiled tension spring 68 secured at one end in a hole 70 in end section 56 and at its other end to a post 72 secured to rear housing portion 16.

Manually operable means, provided for pivoting blade 56 in a counterclockwise direction to cock and actuate the shutter, comprise a bell crank 76 having a central portion 78 at which it is pivotally mounted on a shaft 80 in turn pivotally mounted on a post 81 secured to rear housing portion 16, a manually engageable arm 82 extending exteriorly of the housing 10 through a slot formed therein, an actuating arm 84 extending from central portion 78 and a spacing washer 85 mounted on shaft 80 between crank 76 and housing portion 12. Crank 76 is biased in a clockwise direction by a tension spring 86 anchored at one end in bracket 74 and secured at its other end in an ear 88 extending from central portion 78 of crank 76. An elongated connecting lever 90 is pivotally secured at one end to the end of

arm 84 and includes a right angle end section 92 at which lever 90 is pivotally secured to enlarged end section 64 of cover blind 56 at a point to the right (viewing Fig. 2) of the axis of slot 58 and the center of lens aperture 18. To actuate the shutter, the operator grasps and moves the portion of arm 82 extending exteriorly of the housing to the right to pivot crank 76 in a counterclockwise direction, this movement being transmited through connecting lever 90 pivoting blade 56 in a counterclockwise direction.

To pivot shutter disc 38 in a counterclockwise direction into cocked position, end section 64 of cover blind 56 is provided with a tab 94 turned in from its end toward the rear of the shutter and disc 38. Shutter disc 38 includes a plurality of ratchet-like shouldered portions 96 uniformly spaced around its periphery and adapted to be engaged by tab 94 during pivotal movement of blade 56 in a counterclockwise direction. Disc 38 includes one shoulder 96 for each exposure slot 40, each shoulder being so positioned as to be engaged by tab 94 when the slot 40, associated with the shoulder, is in position (at the left of the lens aperture) for making an exposure. As cover blind 56 is pivoted in a counterclockwise direction, tab 94 engages a shoulder 96, pivoting shutter disc 38 so that an exposure slot 40, together with end section 64 of blind 56, is moved to the right past lens aperture 18 into cocked position. When disc 38 reaches this predetermined cocked position, blade 56 moves in a linear direction parallel to the axis of slot 58 so that tab 94 is disengaged from the shoulder 96, releasing shutter disc 38 for pivotal movement in a clockwise direction under the bias of spring 46. To insure the rapid linear movement of blade 56 parallel to the axis of slot 58 at the proper moment during its pivotal movement, there is provided a coiled hairpin-type spring 98 having elongated ends, one of which is anchored in end section 66 of cover blind 56 at hole 70 and the other of which is anchored to a post 100 secured to rear housing portion 16. During movement of disc 38 into cocked position, cover blind 56 is urged upward (viewing Fig. 2) by lever 90 so that tab 94 is held in engagement with a shoulder 96. Cover blind 56 is pivoted, for example, through approximately 45° during cocking movement of shutter disc 38 so that at cocked position, the upward force exerted on blade 56 is no longer sufficient to prevent the linear movement of blade 56 under the bias of both springs 68 and 98, the effectiveness of which is increased as cover blind 56 is rotated. The point in the rotation of blade 56 at which linear movement and release of the shutter disc occurs is dependent upon the strength of springs 68 and 98, their positions and the direction of force exerted thereby. The release of shutter disc 38 for rotation under the bias of spring 46 is adapted to occur as end section 64 of cover blind 56 is pivoted out of alignment with the lens aperture and said aperture is uncovered. It is during the clockwise rotation of disc 38 that a slot 40 crosses the lens aperture to make an exposure, and upon release of crank 76, cover blind 56 returns to its original position of rest due to the bias of spring 68 and crank 76 returns under the bias of spring 86.

Means are provided for completing an electrical circuit to a photoflash lamp (not shown) in synchronism with the operation of the shutter mechanism and, in the form shown, comprises a resilient conducting arm 102 mounted at one end on an insulating member 104 secured to rear housing portion 16. Arm 102 is insulated from the remainder of the shutter mechanism and is connected with one terminal of a conventional receptacle or plug 106 secured to insulating member 104. The other terminal of plug 106 is grounded in the shutter housing together with connecting lever 90, and to insure a low resistance circuit through lever 90, the latter is connected to the grounded terminal of plug 106 by a lead wire 108. Conducting arm 102 is so positioned with

respect to connecting lever 90 that the end of lever 90 contacts the free end of arm 102, completing a photoflash circuit when cover blind 56, together with lever 90 secured thereto, moves linearly parallel to the axis of slot 58 (generally to the right) at the moment of release of shutter disc 38 for rotation. To provide for optimum contact between lever 90 and arm 102, a flange 93 may be formed turned up from the end of lever 90 and adapted to make contact with conducting arm 102 to complete the circuit.

The shutter includes means for holding an exposure slot 40 in shutter disc 38 in an aperture-uncovering position during time exposures and, in the form shown in Figs. 2 and 5, comprises an L-shaped section 110 of detent spring 34 having a short dependent end section 112 adapted to engage shoulders 96 and thereby retain shutter disc 38 in a position with a slot 40 in alignment with the lens aperture. As a means for positioning end section 112 for engagement with a shoulder 96, shaft 80, pivotally mounted on post 81, includes a cam portion 114 positioned to engage and deform L-shaped section 110 of detent spring 34. Section 110 is normally so biased as to urge end section 112 toward shutter disc 38, cam portion 114 being pivotable into an "instantaneous" exposure position wherein it deforms section 110 so as to hold end section 112 out of engagement with shutter disc 38, and is pivotable into a "bulb" or time exposure position wherein it is out of engagement with section 110 of the detent spring and permits end section 112 to move toward shutter disc 38. A manually engageable knob 116 extending exteriorly of front housing portion 12 may be secured to shaft 80 for manually rotating said shaft and said cam section from one position to the other. In operation, in order to make a time exposure, cam section 114 is pivoted in a clockwise direction to the position shown in Fig. 2 allowing end section 112 to move into a position closely adjacent or in contact with the periphery of shutter disc 38. The shutter may then be cocked and actuated as previously described, and during the clockwise movement of the shutter disc a shoulder 96 is engaged by end section 112, thereby retaining a shutter slot 40 in alignment with the lens aperture. The duration of the time exposure is determined by the interval during which the operator holds cover blind 56 at its aperture-uncovering position and may be terminated by releasing actuating crank 76 to allow cover blind 56 to return to an aperture-covering position. The shutter remains set for time exposure and subsequent time exposures are effected in the same manner until cam section 114 is pivoted counterclockwise approximately 90° to an inoperable or "instantaneous" exposure position to withdraw spring 34 from engagement with a shoulder 96. A pair of pins 118 may be provided secured to rear housing portion 16 for limiting the pivotal movement of cam section 114. Suitable means may also be provided in association with cam section 114 and cooperating with crank 76 for automatically returning end section 112 of spring 34 to "instantaneous" exposure position following each time exposure. In addition, it is apparent that satisfactory time exposures can best be made using an exposure slot 40 which is longer than the diameter of the exposure aperture and in a shutter wherein disc 38 includes exposure slots of shorter length, means, such as a cam secured to diaphragm disc 20 and adapted to engage and retain end 112 of spring 34 out of engagement with shutter disc 38, may be provided. In a like manner, means such as an electrically insulated cam secured to disc 20 may be provided for engaging and deforming conducting arm 102 so that the flash circuit cannot be completed unless one of certain exposure slots 40, which are so formed as to provide an exposure in synchronism with the peak illumination of the flash lamp, is in position to provide the exposure.

Since certain changes may be made in the above apparatus without departing from the scope of the inven-

tion herein involved, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. A shutter for photographic apparatus comprising, in combination, housing means having an exposure aperture formed therein, diaphragm means having a plurality of diaphragm apertures formed therein, said diaphragm means being mounted upon said housing for movement to a plurality of positions, at each of which positions said diaphragm means provides a diaphragm aperture coincident with said exposure aperture, a shutter element having a plurality of openings therein, said shutter element being mounted upon said housing in covering relation to said exposure aperture and being movable independently of said diaphragm means between a first aperture-covering position, wherein one of said openings is located to one side of said exposure aperture, and a second aperture-covering position, wherein said one opening is located to the other side of said exposure aperture, said shutter element being movable with said diaphragm means to a plurality of different first aperture-covering positions, each of said first aperture-covering positions of said shutter element being in a substantially fixed correspondence with a particular diaphragm aperture of said diaphragm means, resilient means for biasing said shutter element into said first aperture-covering position, a cover element mounted upon said housing for movement between a position occluding said exposure aperture and a position uncovering said exposure aperture, spring means for biasing said cover element into said occluding position, means for moving said shutter element from said first aperture-covering position to said second aperture-covering position against the bias of said resilient means, means for releasing said shutter element for return movement under the bias of said resilient means from said second aperture-covering position to said first aperture-covering position, during said return movement one of said openings in said shutter being coincident with said exposure aperture, and means for moving said cover element to said uncovering position during said return movement of said shutter element.

2. A shutter for photographic apparatus comprising, in combination, housing means having an exposure aperture formed therein, a disc-like diaphragm having a plurality of diaphragm apertures of different diameters formed therein, said diaphragm being mounted on said housing for movement to a plurality of positions, at each of which positions said diaphragm provides a diaphragm aperture coincident with said exposure aperture, a rotary shutter element having a plurality of openings therein, said shutter element being mounted on said housing in covering relation to said exposure aperture and being movable independently of said diaphragm between a first aperture-covering position, wherein one of said openings is located to one side of said exposure aperture, and a second aperture-covering position wherein said one opening is located to the other side of said exposure aperture, said shutter element being movable with said diaphragm to a plurality of different first aperture-covering positions, each of said first aperture-covering positions of said shutter element being in a substantially fixed correspondence with a particular diaphragm aperture of said diaphragm, resilient means for biasing said shutter element into said first aperture-covering position, a cover element mounted on said housing for movement between a position occluding said exposure aperture and a position uncovering said exposure aperture, spring means for biasing said cover element into said occluding position, means comprising portions of said cover element cooperating with portions of said shutter element for engaging and moving said shutter element from said first aperture-covering position to said second aperture-covering position against the bias of said resilient means, means for releasing said shutter element for return movement under the bias of said resilient means from said second aperture-covering position to said first aperture-covering position, one of said openings in said shutter being coincident with said exposure aperture during said return movement, and means for moving said cover element to said uncovering position during said return movement of said shutter element.

3. A shutter for photographic apparatus comprising, in combination, housing means having an exposure aperture formed therein, a disc-like diaphragm having a plurality of diaphragm apertures of different diameters formed therein, said diaphragm being mounted on said housing for movement to a plurality of positions, at each of which positions said diaphragm provides a diaphragm aperture coincident with said exposure aperture, a rotary shutter element having a plurality of slots of different lengths formed therein, said shutter element being mounted on said housing in covering relation to said exposure aperture and being movable independently of said diaphragm between a first aperture-covering position wherein one of said slots is located to one side of said exposure aperture and a second aperture-covering position wherein said one slot is located to the other side of said exposure aperture, said slot providing for an uncovered exposure aperture during movement of said shutter from said second aperture-covering position to said first aperture-covering position, means comprising portions of said diaphragm cooperating with portions of said shutter element for engaging and moving said shutter element with said diaphragm to a plurality of different first aperture-covering positions, each of said first aperture-covering positions of said shutter element being in a substantially fixed correspondence with a particular diaphragm aperture of said diaphragm, resilient means for biasing said shutter element into said first aperture-covering position, a cover element mounted on said housing for movement between a position occluding said exposure aperture and a position uncovering said exposure aperture, spring means for biasing said cover element into said occluding position, means comprising portions of said cover element cooperating with portions of said shutter element for engaging and moving said shutter element from said first aperture-covering position to said second aperture-covering position against the bias of said resilient means, means for releasing said shutter element for return movement under the bias of said resilient means from said second aperture-covering position to said first aperture-covering position, and means for moving said cover element to said uncovering position during said return movement of said shutter element.

4. A shutter for photographic apparatus comprising, in combination, housing means having an exposure aperture formed therein, a rotary diaphragm disc having a plurality of diaphragm apertures of different diameters formed therein, said diaphragm being rotatably mounted on said housing for movement to a plurality of positions at each of which positions said diaphragm provides a diaphragm aperture coincident with said exposure aperture, a disc-like shutter element having a plurality of arcuate slots of different lengths formed therein for movement across said exposure aperture, said shutter element being rotatably mounted on said housing coaxially with said diaphragm adjacent the latter and being in covering relation to said exposure aperture, said shutter element being movable independently of said diaphragm between a first aperture-covering position wherein one of said slots is located to one side of said exposure aperture and a second aperture-covering position wherein said one slot is located to the other side of said exposure aperture, means comprising portions of said diaphragm cooperating with portions of said shutter element for engaging and moving said shutter element with said diaphragm to a plurality of different first aperture-covering positions, each of said first aperture-covering positions of

said shutter element being in a substantially fixed correspondence with a particular diaphragm aperture of said diaphragm, resilient means for biasing said shutter element into said first aperture-covering position, a rotatable cover element mounted coaxially with said shutter element and adjacent the latter, said cover element being movable between a position occluding said exposure aperture and a position wherein said exposure aperture is uncovered, spring means for biasing said cover element into said occluding position, means comprising portions of said cover element cooperating with portions of said shutter element for engaging and moving said shutter element from said first aperture-covering position to said second aperture-covering position against the bias of said resilient means, means for moving said cover element to said uncovering position, and means for moving said cover element from engagement with said shutter element for return movement of said shutter element under the bias of said resilient means from said second aperture-covering position to said first aperture-covering position when said cover element is in said uncovering position.

5. A shutter for photographic apparatus comprising, in combination, housing means having an exposure aperture formed therein, a rotary diaphragm disc having a plurality of diaphragm apertures of different diameters formed therein, said diaphragm being rotatably mounted on said housing for movement to a plurality of positions at each of which said diaphragm provides a diaphragm aperture coincident with said exposure aperture, means for retaining said diaphragm disc at any of said plurality of positions, a disc-like rotary shutter element having a plurality of arcuate slots of different lengths formed therein for movement across said exposure aperture from a second aperture-covering position to a first aperture-covering position, thus providing a plurality of different exposure speeds, said shutter element being rotatably mounted on said housing coaxially with said diaphragm adjacent the latter and being in covering relation to said exposure aperture, said shutter element being pivotable independently of said diaphragm between said first aperture-covering position wherein one of said slots is located to one side of said exposure aperture and said second aperture-covering position wherein said one slot is located to the other side of said exposure aperture, the exposure time being a function of the length of a given slot, means comprising portions of said diaphragm cooperating with portions of said shutter element for engaging and rotating said shutter element with said diaphragm to a plurality of different first aperture-covering positions and thereby providing for a plurality of different exposure times, each of said first aperture-covering positions of said shutter element being in a substantially fixed correspondence with a particular diaphragm aperture of said diaphragm, said diaphragm disc having inscribed thereon a plurality of indicia indicating correlated positions of said diaphragm apertures with said shutter element, resilient means for biasing said shutter element into said first aperture-covering position, a rotatable cover element mounted coaxially with said shutter element and adjacent the latter, said cover element being movable between a position occluding said exposure aperture and a position wherein said exposure aperture is uncovered, spring means for biasing said cover element into said occluding position, means comprising portions of said cover element cooperating with portions of said shutter element for engaging and moving said shutter element from said first aperture-covering position to said second aperture-covering position against the bias of said resilient means, means for moving said cover element to said uncovering position, and means for moving said cover element from engagement with said shutter element for return movement of said shutter element under the bias of said resilient means from said second aperture-covering position to said first aperture-covering position when said cover element is in said uncovering position.

6. A shutter for photographic apparatus comprising, in combination, a housing having an exposure aperture formed therein, a rotary diaphragm disc having a plurality of diaphragm apertures of different diameters formed therein, said diaphragm being rotatably mounted on said housing for movement to a plurality of settings, means for retaining said diaphragm disc at any one of said plurality of settings wherein one of said diaphragm apertures is in coincidence with said exposure aperture, a disc-like shutter element having a plurality of arcuate slots of different lengths formed therein for movement across said exposure aperture and mounted for rotary movement coaxially with said diaphragm disc adjacent the latter, said shutter element being pivotable independently of said diaphragm disc between a plurality of first aperture-covering positions, wherein one of said slots is disposed adjacent and at one side of said exposure aperture and the latter is covered by said element, and a second aperture-covering position, wherein said one slot is disposed adjacent and at the other side of said exposure aperture, means comprising portions of said diaphragm disc cooperating with portions of said shutter element for rotating said shutter element to a plurality of different first aperture-covering positions during rotary movement of said diaphragm disc to a particular setting and thereby providing for a plurality of exposure times, said shutter element providing for an uncovered exposure aperture as any one of said slots moves across said exposure aperture during said independent pivotal movement of said shutter element from said second aperture-covering position to said first aperture-covering position, the exposure time being a function of the length of said slot, the length of each one of said slots in said shutter element being correlated with a particular diaphragm aperture for providing a plurality of predetermined exposure values, said diaphragm disc having portions extending exteriorly of the shutter housing and manually engageable for rotating said diaphragm disc to one of said correlated settings, resilient means for causing the return movement of said shutter element from said second aperture-covering position to said first aperture-covering position, a cover element mounted for rotary movement coaxially with said shutter element and thereadjacent, said cover element providing a closure for said exposure aperture when in an occluding position and being pivotable to a displaced position wherein said exposure aperture is uncovered, means comprising a portion of said cover element for engaging and rotating said shutter element to said second aperture-covering position during pivotal movement of said cover element to an aperture-uncovering position, said cover element providing a closure for said aperture during said last pivotal movement and means for effecting the movement of said cover element when the latter is in aperture-uncovering position to disengage said shutter element and release the latter for return movement to said first aperture-covering position.

7. A shutter for photographic apparatus comprising, in combination, a housing having an exposure aperture formed therein, pivot means mounted within said housing, a disc-like diaphragm mounted for rotary movement on said pivot means and having a plurality of diaphragm apertures of different diameter formed therein, said diaphragm being rotatable to a plurality of settings at each of which settings said diaphragm provides a diaphragm aperture coincident with said exposure aperture, a shutter element having a plurality of openings therein and being mounted on said pivot means for rotary movement relative to said housing and said diaphragm, said shutter element providing a closure for said exposure aperture when at a first aperture-covering position and being rotatable to and from a second aperture-covering position and providing for an opening for said exposure aperture dur-

ing return movement from said second aperture-covering position to said first aperture-covering position, spring means mounted between and cooperating with said diaphragm and said shutter element for causing the return movement of the latter to said first aperture-covering position from said second aperture-covering position, means comprising portions of said diaphragm for providing a plurality of first aperture-covering positions of said shutter element during rotation of said diaphragm and for limiting the rotary movement of said shutter element relative to said diaphragm, resilient retaining means positioned in engagement with said diaphragm and cooperating with portions thereof for permitting rotary movement of said diaphragm in only one direction and for retaining said diaphragm in stationary position wherein one of said diaphragm apertures is in coincidence with said exposure aperture during rotary movement of said shutter element relative to said diaphragm, a cover element mounted for rotary movement on said pivot means and for movement in a plane substantially perpendicular to the axis of said pivot means, said cover element providing a closure for said exposure aperture when at an occluding position and being pivotable to a displaced position wherein said exposure aperture is uncovered, means for pivoting said cover element to an aperture-uncovering position, means comprising a portion of said cover element for engaging and rotating said shutter element to said second aperture-covering position during rotary movement of said cover element to an aperture-uncovering position, said cover element providing cover for said exposure aperture during said rotation of said shutter element to said second aperture-covering position and spring means so positioned in engagement with said cover element as to cause its movement in said plane when in aperture-uncovering position for disengaging said shutter element and releasing the latter for return movement to said first aperture-covering position.

8. A shutter for photographic apparatus comprising, in combination, a housing having an exposure aperture formed therein, a rotary disc-like diaphragm having a plurality of diaphragm apertures of different diameter formed therein for rotation to and from a setting wherein each of said diaphragm apertures may be made coincident with said exposure aperture, a rotary shutter element having a plurality of openings therein, said shutter element being in a covering relation to said exposure aperture when at a first aperture-covering position and providing for an opening for said exposure aperture during return movement from a second aperture-covering position to said first aperture-covering position, said shutter element being pivotable to a plurality of first aperture-covering positions, means comprising portions of said diaphragm cooperating with portions of said shutter element for altering said first aperture-covering positions of the latter during rotary movement of said diaphragm, each of said first aperture-covering positions being in a substantially fixed correspondence with a particular diaphragm aperture of said diaphragm, a rotary cover element providing a closure for said exposure aperture when at an occluding position and pivotable to a displaced position for uncovering said exposure aperture, said rotary cover element being mounted for linear movement in a plane substantially perpendicular to its axis of rotation, means for pivoting said cover element to an aperture-uncovering position, means comprising a portion of said cover element for engaging and rotating said shutter element to said second aperture-covering position during rotary movement of said cover element, and means for effecting the linear movement of said cover element when the latter is in aperture-uncovering position to disengage said shutter element and release the latter for return movement to said first aperture-covering position.

9. A shutter for photographic apparatus comprising, in combination, a housing having an exposure aperture formed therein, a rotary diaphragm disc having a plurality of diaphragm apertures of different diameter formed therein for rotation to and from a setting wherein each of said diaphragm apertures may be made coincident with said exposure aperture, a rotary disc-like shutter element having a plurality of slots of different lengths formed therein for movement across said exposure aperture, said shutter element being pivotable to a plurality of first aperture-covering positions wherein one of said slots is disposed adjacent and at one side of said exposure aperture and the latter is covered, means comprising portions of said diaphragm disc cooperating with portions of said shutter element for altering the first aperture-covering positions of the latter during rotary movement of said diaphragm disc, each of said first aperture-covering positions being in a substantially fixed correspondence with a particular diaphragm aperture of said diaphragm, said shutter element providing for an uncovering of said exposure aperture during movement of one of said slots across said exposure aperture during rotary movement thereof from a second aperture-covering position, wherein said one slot is disposed adjacent and at one side of said exposure aperture and the latter is covered, to said first aperture-covering position, resilient means for causing the return movement of said shutter element from said second aperture-covering position to said first aperture-covering position, a rotary cover element providing a closure for said exposure aperture when at an occluding position and being pivotable to a displaced position for uncovering said exposure aperture, said rotary cover element being mounted for linear movement in a plane substantially perpendicular to its axis of rotation, means for pivoting said cover element to an aperture-uncovering position, means comprising a portion of said cover element for engaging and rotating said shutter element to said second aperture-covering position during rotary movemen of said cover element to an aperture-uncovering position, and means for effecting the linear movement of said cover element when the latter is in aperture-uncovering position to disengage said shutter element and release the latter for return movement to said first aperture-covering position.

10. A shutter for photographic apparatus comprising in combination, a housing having an aperture formed therein, diaphragm means mounted for movement to a plurality of positions wherein it provides diaphragm apertures of different areas, a shutter element providing closure for said exposure aperture when at a first aperture-covering position and a second aperture-covering position and providing for an uncovering of said exposure aperture during return movement from said second aperture-covering position to said first aperture-covering position, means for biasing said shutter element into said first aperture-covering position, said shutter element being movable to a plurality of first aperture-covering positions in which it provides for different exposure speeds, means comprising portions of said diaphragms means for controlling the first aperture-covering positioning of said shutter element so that the latter is set for a particular exposure speed with each setting of one of said diaphragm apertures, a rotary cover element disposed in occluding relation to said exposure aperture and pivotable to an aperture-uncovering position, said cover element being mounted on said housing for linear movement in a plane substantially perpendicular to its axis of rotation and including means adapted to engage and move said shutter element into said second aperture-covering position during rotary movement of said cover element into aperture-uncovering position, means for pivoting said cover element into aperture-uncovering position, and means for effecting the linear movement of said cover element when in aperture-uncovering position for releasing said shutter element for return movement from said second aperture-covering position to said first aperture-covering position.

11. A shutter for photographic apparatus comprising, in combination, a housing having an exposure aperture formed therein, a rotary diaphragm disc having a plurality of diaphragm apertures of different diameter formed therein for rotation to and from a plurality of settings at each of which settings said diaphragm disc provides a diaphragm aperture coincident with said exposure aperture, means for retaining said diaphragm disc at said plurality of settings, a rotary disc-like shutter element having a plurality of arcuate slots of different lengths formed therein for movement across said exposure aperture and providing a plurality of different exposure speeds, said shutter element being pivotable independently of said diaphragm disc between a first aperture-covering position wherein one of said slots is disposed adjacent and at one side of said exposure aperture and a second aperture-covering position wherein said one slot is disposed adjacent and at the other side of said exposure aperture, the latter being covered by said element, means comprising portions of said diaphragm disc cooperating with portions of said shutter element for engaging and pivoting the latter during rotary movement of said diaphragm disc to a plurality of settings and thereby altering the exposure time, said shutter element providing for an uncovering of said exposure aperture during movement of one of said slots across said exposure aperture during rotary movement of said shutter element from said second aperture-covering position to said first aperture-covering position, the exposure time being a function of the length of said one slot, resilient means for causing the return movement of said shutter element from said second aperture-covering position to said first aperture-covering position, said diaphragm disc having inscribed thereon a plurality of indicia indicating correlated settings of said diaphragm apertures and said shutter element, a rotary cover element providing a closure for said exposure aperture when at an occluding position and being pivotable to a displaced position for uncovering said exposure aperture, said rotary cover element being mounted for linear movement in a plane substantially perpendicular to its axis of rotation, means for pivoting said cover element to an aperture-uncovering position, means comprising a portion of said cover element for engaging and rotating said shutter element to said second aperture-covering position during rotary movement of said cover element when the latter is in aperture-uncovering position to disengage said shutter element and release the latter for return movement to said first aperture-covering position.

12. A shutter for photographic apparatus comprising, in combination, a housing having an exposure aperture formed therein, a rotary diaphragm disc having a plurality of diaphragm apertures of different diameter formed therein for rotation to and from a plurality of settings at each of which settings said diaphragm disc provides a diaphragm aperture coincident with said exposure aperture, means for retaining said diaphragm disc at any one of said plurality of settings, a disc-like shutter element having a plurality of arcuate slots of different lengths formed therein for movement across said exposure aperture and mounted for rotary movement coaxially with said diaphragm disc adjacent the latter, said shutter element being pivotable independently of said diaphragm disc between a first aperture-covering position wherein one of said slots is disposed adjacent and at one side of said exposure aperture and a second aperture-covering position wherein said one slot is disposed adjacent and at the other side of said exposure aperture and the latter is covered by said element, means comprising portions of said diaphragm disc cooperating with portions of said shutter element for engaging and pivoting the latter during rotary movement of said diaphragm disc to a particular setting and thereby altering the exposure time, said shutter element providing for an uncovering of said exposure aperture as one of said slots moves across said exposure aperture during rotary movement of said shutter

element from said second aperture-covering position to said first aperture-covering position, the exposure time being a function of the length of said slot, the length of each one of said slots in said shutter element being correlated with a particular diaphragm aperture for providing a plurality of predetermined exposure values, said diaphragm disc having portions extending exteriorly of said shutter housing and manually engageable for rotating said diaphragm disc to one of said correlated settings, resilient means for causing the return movement of said shutter element from said second aperture-covering position to said first aperture-covering position, a cover element mounted for rotary movement coaxially with said shutter element and for linear movement in a plane substantially perpendicular to its axis of rotation, said cover element providing a closure for said exposure aperture when in an occluding position and being pivotable to a displaced position wherein said exposure aperture is uncovered, means for pivoting said cover element to an aperture-uncovering position, means comprising a portion of said cover element for engaging and rotating said shutter element to said second aperture-covering position during rotary movement of said cover element to an aperture-uncovering position, said cover element occluding said exposure aperture until said shutter element has reached said second aperture-covering position, and means for effecting the linear movement of said cover element when the latter reaches said aperture-uncovering position to disengage said shutter elements and release the latter for return movement to said first aperture-covering position.

13. A shutter for photographic apparatus comprising, in combination, a housing having an exposure aperture formed therein, pivot means mounted within said housing, a disc-like diaphragm mounted for rotary movement on said pivot means and having a plurality of diaphragm apertures of different diameter formed therein for rotation to and from a plurality of settings at each of which settings said diaphragm disc provides a diaphragm aperture coincident with said exposure aperture, a shutter element mounted on said pivot means for rotary movement relative to said housing and said diaphragm, said shutter element providing a closure for said exposure aperture when at a first aperture-covering position and providing for an uncovering of said exposure aperture during return movement from a second aperture-covering position to said first aperture-covering position, spring means mounted between and cooperating with said diaphragm and said shutter element for causing the return movement of the latter to said first aperture-covering position from said second aperture-covering position, means comprising portions of said diaphragm for providing a plurality of first aperture-covering positions of said shutter element during rotation of said diaphragm and for limiting the rotary movement of said shutter element relative to said diaphragm, resilient retaining means positioned in engagement with said diaphragm and cooperating with portions thereof for permitting rotary movement of said diaphragm in only one direction and for retaining said diaphragm in a plurality of stationary positions at each of which positions one of said diaphragm apertures is in coincidence with said exposure aperture during rotary movement of said shutter element relative to said diaphragm, a cover element mounted for rotary movement on said pivot means and for linear movement in a plane substantially perpendicular to the axis of said pivot means, said cover element providing a closure for said exposure aperture when at an occluding position and being pivotable to a position wherein said exposure aperture is uncovered, means for pivoting said cover element to said aperture-uncovering position, means comprising a portion of said cover element for engaging and rotating said shutter element to said second aperture-covering position during rotary movement of said cover element to an aperture-uncovering position, and spring means so posi-

tioned in engagement with said cover element as to cause its linear movement in said plane when in aperture-uncovering position for disengaging said shutter element and releasing the latter for return movement to said first aperture-covering position, said cover element occluding said exposure aperture until said shutter element has been disengaged.

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